



Learning and Action Alliance framework to facilitate stakeholder collaboration and social learning in urban flood risk management

E.C. O'Donnell^{a,*}, J.E. Lamond^b, C.R. Thorne^a

^a School of Geography, University of Nottingham, Nottingham, NG7 2RD, UK

^b Centre for Floods, Communities and Resilience, University of the West of England, Bristol, BS16 1QY, UK

ARTICLE INFO

Keywords:

Social learning

Flood risk management

Learning and action alliance

Blue-Green infrastructure

Stakeholder participation

ABSTRACT

Flood and water management governance may be enhanced through partnership working, intra- and cross-organisational collaborations, and wide stakeholder participation. Nonetheless, barriers associated with ineffective communication, fragmented responsibilities and 'siloed thinking' restrict open dialogue and discussion. The Learning and Action Alliance (LAA) framework may help overcome these barriers by enabling effective engagement through social learning, and facilitating targeted actions needed to deliver innovative solutions to environmental problems. By increasing the adaptive capacity of decision-makers and participants, social learning through LAAs may lead to concerted action and sustained processes of behavioural change. In this paper, we evaluate the LAA framework as a catalyst for change that supports collaborative working and facilitates transition to more sustainable flood risk management. We use a case study in Newcastle-upon-Tyne, UK, to demonstrate how the LAA framework brought together disparate City stakeholders to co-produce new knowledge, negotiate innovative actions and, ultimately, work towards implementing a new vision for sustainable urban flood risk management. The shared vision of Newcastle as a 'Blue-Green City' that emerged is founded on a strong platform for social learning which increased organisations' and individuals' capacities to manage differences in perspectives and behaviours, reframe knowledge, and make collective decisions based on negotiation and conflict resolution. Broad recommendations based on lessons learned from the Newcastle LAA are presented to aid other cities and regions in establishing and running social learning platforms.

1. Introduction

In England and Wales, annual expected damages due to flooding exceed £1 billion (Environment Agency, 2014) and are predicted to rise due to projected increases in the frequency, intensity and magnitude of storm events (Ramsbottom et al., 2012). This is a particular issue for cities, which predominantly comprise impermeable surfaces and rely on piped drainage systems (Ashley et al., 2015). Future urban flood risks are further exacerbated by increasing urban development which, over the next 50 years, may lead to a 60–220% increase in damages caused by surface water flooding (Adaptation Sub-Committee, 2012). In responding to these predictions, the UK has moved from flood defence to flood risk management, investing in portfolios of Urban Flood Risk Management (UFRM) measures, rather than being over-reliant on engineered structures (Defra, 2005). This has led to an ongoing transition from solely 'grey' infrastructure towards more resilient approaches that recognise the contributions possible using Nature-Based Solutions in the wider catchment (Environment Agency, 2010), Sustainable Drainage Systems (SuDS) and other multi-functional infrastructure in 'Blue-

Green Cities'.

A Blue-Green City aims to recreate a naturally-oriented water cycle, combining water management and green infrastructure to generate multiple benefits (Hoyer et al., 2011). Blue-Green Infrastructure (BGI) including bioswales, attenuation basins, rain gardens, green roofs/walls, street trees and restored urban watercourses, mimics pre-development hydrology by increasing interception, infiltration, evapotranspiration and storage. In addition to managing water quantity and reducing flood damages, multifunctional use of blue-green spaces under non-flood conditions generates additional economic, social and environmental benefits (O'Donnell et al., 2017a). BGI can help meet the strategic objectives for climate change adaption, biodiversity, urban regeneration, and public health and wellbeing, while extending the lifetime of existing grey infrastructure. However, it can be challenging to implement BGI as this requires the active involvement of urban stakeholders beyond those traditionally engaged in flood control (O'Donnell et al., 2017b). Consequently, there is a need for new ways of working that focus on collaborative planning, partnerships, and co-funding to deliver multifunctional UFRM infrastructure (Ashley et al.,

* Corresponding author.

E-mail address: emily.o'donnell@nottingham.ac.uk (E.C. O'Donnell).

2015; Margerum and Robinson, 2015). Additionally, experience gained in pioneering cities such as Portland, Oregon, demonstrates that implementing transformative change and creating BGI requires stakeholders to develop long-term, shared visions for achieving urban flood resilience, which requires collaboration between multiple organisations and branches of city government and administration (Thorne et al., 2015).

Such intra- and cross-organisational collaborations, together with broadening stakeholder participation, represent an evolving paradigmatic shift in environmental governance (Benson et al., 2013). Progression from traditional command and control management (Pahl-Wostl et al., 2007) towards collaborative working aligns with recommendations in the UK Flood and Water Management Act (FWMA, 2010). However, collaborative approaches are inherently challenging due to issues related to ineffective communication within and between departments and organisations, fragmented responsibilities, 'siloed' thinking, and constraints on resources that limit communication and knowledge sharing. 'Social' and 'active' learning have been suggested as methods to overcome these barriers by allowing stakeholders to experience different views on best management practices and become better informed before making decisions (Ison et al., 2007; Benson et al., 2016). Social learning, where actors interact to develop alternative perspectives (whether at the individual or group level) on societal issues and collectively enable change (Bos et al., 2013), is a key component of sustainable water management. It emphasises development of adaptive cross-sectoral capacities and co-production of knowledge to respond to dynamic social-ecological systems (Pahl-Wostl et al., 2008). Social learning through Learning and Action Alliances (LAAs) can facilitate changes in working practices by bringing together diverse viewpoints and objectives to negotiate solutions that generate multiple benefits (van Herk et al., 2011a; Ashley et al., 2012). LAAs originate from *Learning Alliances*, defined as "a group of individuals or organizations with a shared interest in innovation and the scaling-up of innovation in a topic of mutual interest" (Batchelor and Butterworth, 2008). Adding *Action* as a second aim emphasises the importance of the LAA in enabling its members to deliver the innovative solutions their collaborative learning identifies (Newman et al., 2011).

This paper illustrates how LAAs can facilitate social learning to develop the capacity of different stakeholder groups to coalesce around innovative UFRM solutions. We begin by outlining the concept of social learning before introducing the LAA framework. We then demonstrate the capacity of LAAs to catalyse and synergise changing practices through collaborative working that facilitates the transitions required to deliver sustainable UFRM. We use a Newcastle case study to demonstrate how LAAs can work in practice. Finally, lessons learned from the Newcastle LAA are summarised and recommendations for enhancing social learning through LAAs are proposed.

2. Social learning through LAAs

While social learning remains a contest term (see discussions in Pahl-Wostl et al. (2007) and Benson et al. (2016)), the importance of gaining new knowledge to enable change is paramount in all definitions.

2.1. Benefits of social learning in transformative thinking

Social learning may be equated with individual level change (Bandura, 1977), collective level change (interpersonal change within wider social contexts, e.g. Pahl-Wostl, 2009), and/or collective learning; where social or institutional transformations at the group level are achieved through learning across members of a group (Gerlak and Heikkilä, 2011). Social learning increases the adaptive capacity of decision makers and participants and, through interaction and deliberation, may lead to joint action and sustained processes of behavioural change (Pahl-Wostl et al., 2007). Social learning can also be seen to

contribute to greater depth in learning as categorised by single, double and triple loop learning (Hurlbert and Gupta, 2017). According to Medema et al. (2014), multi-loop social learning is an essential element of land and water management in order to recognise the limitations of institutional and governance structures and to explore more participatory models. Development of trust between participants in the social space allows for "problem fixing" changes in practice (single loop), deeper understanding leading to institutional changes (double loop) and discussion of fundamental assumptions including expression of doubts in accepted norms and values (triple loop) (Hurlbert and Gupta, 2017). This kind of learning leads to transformation because it asks the question "how do we decide what is the right thing to do" (Medema et al., 2014), potentially leading to calls for policy and governance changes. On an individual level it can fundamentally shift perspectives, attitudes and behaviours. Social learning is closely associated with triple loop learning because the required depth of discussion is difficult to foster within hierarchies and can more readily occur between peers in less formal learning environments. In the context of LAAs, social learning can be achieved at the individual level, e.g. change in individual attitudes through the acquisition of new knowledge, and collective level, e.g. community interaction leading to joint understanding of a problem and mutually agreed action. Effective multi-loop social learning in LAAs can be demonstrated by short-term changes (e.g. new collaborating stakeholders) and long-term changes in policies and governance structures. Social learning may thus be regarded as a duality that combines the dynamics of practice with a governance framing that is supportive of that practice, and therefore a systemic approach to governance (Ison et al., 2013).

2.2. The LAA framework

The LAA framework represents a viable mechanism to facilitate social learning through the creation of a negotiated vision to address 'wicked' problems. LAAs are open arrangements wherein participants with a shared interest in innovation and implementing change create a joint understanding of a problem and its possible solutions based on rational criticism and discussion (Ashley et al., 2012). LAAs promote cooperation between stakeholders from different disciplines and backgrounds by breaking down barriers to both horizontal and vertical information sharing and accelerating identification, adaptation and uptake of new information (Batchelor and Butterworth, 2008). Continued processes of social learning allow stakeholders to create flexible networks, building the trust necessary to enable collaboration through formal and informal relationships (Pahl-Wostl et al., 2007).

LAAs encourage stakeholders to bring their knowledge and expertise and talk freely outside the constraints of existing formal institutional settings. They share many attributes with alternative stakeholder platforms and social learning environments, but the emphasis is on *development* rather than *transfer* of knowledge through joint learning where there are no established experts (Gourgoura et al., 2015). The atmosphere of mutual ownership increases adaptive capacity and facilitates the identification of innovative ideas for the solution of complex socio-technical problems and allows temporary setting aside of organisational "interests" in favour of the alliance. Development of shared meaning and values provides the basis for such collective action (Pahl-Wostl et al., 2007). The ultimate goal is for ideas developed at LAA meetings to be progressed through formal decision-making channels, not only leading to implementation of innovative solutions, but also bringing about institutional change (Verhagen et al., 2008).

LAAs are dynamic groupings that evolve organically. They are often led by academic research projects with the freedom to address sensitive or controversial issues without a perceived hidden agenda. Responsibilities typically pass to other members after initial relationships and working arrangements have been established. LAAs have been trialled as frameworks to tackle urban flood and water management in the UK, Netherlands, Germany and Norway, as part of EU

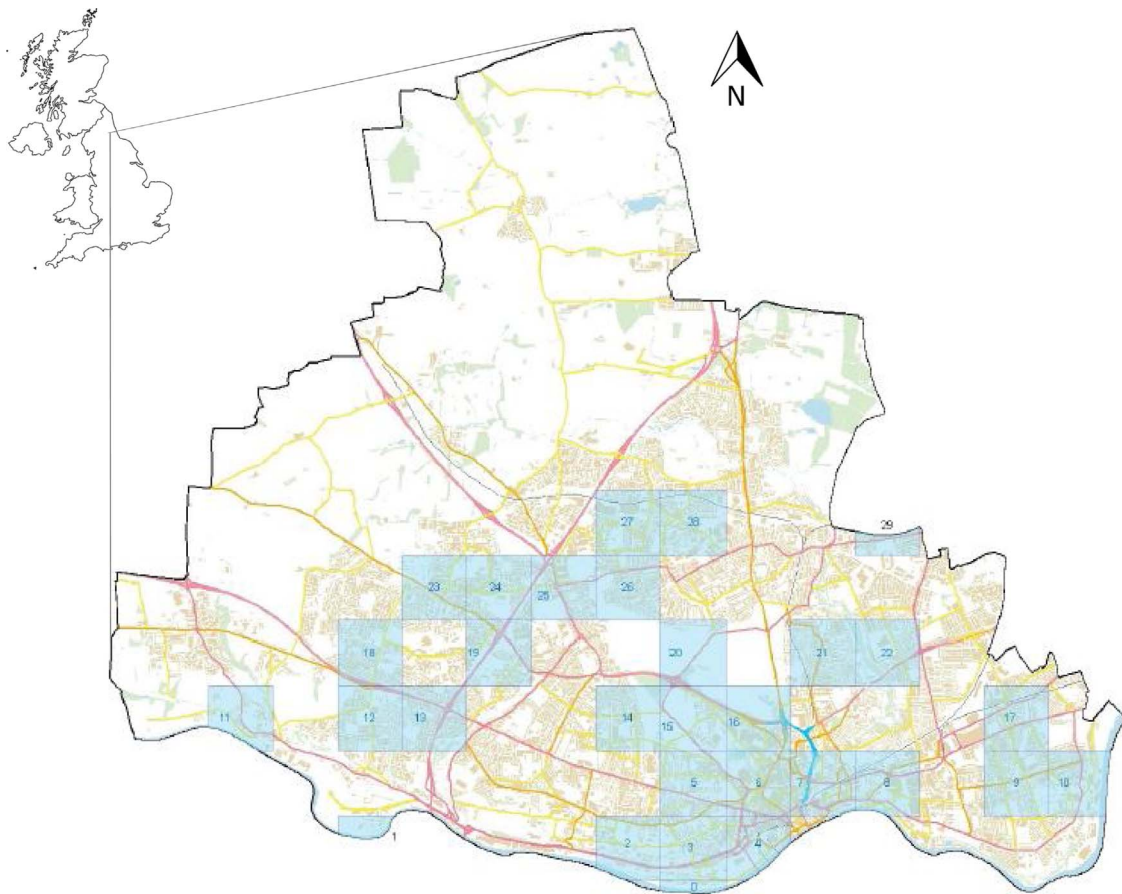


Fig. 1. Significant future flood risk in Newcastle. Shaded squares denote areas above future flood risk thresholds. Source: Newcastle City Council Preliminary Flood Risk Assessment Final Report, 2011

INTERREG IVb and Dutch research programmes. Dutch LAAs significantly influenced development of local urban masterplans (van Herk et al., 2011a), while the Yorkshire and Humber LAA became part of the formal process for delivering regional flood risk management (Ashley et al., 2012). The benefits of joining include networking opportunities, including access to stakeholders that would otherwise be difficult to reach; the chance to learn from and freely contribute to discussion outside their professional remit, and; the capacity to share data, knowledge and contacts. LAAs are also effective mechanisms for integrating academic research with the needs of key stakeholders to improve research impact (Sutherland et al., 2012).

3. Case study: the Newcastle LAA

Many areas across Newcastle are at risk of significant future flooding (Fig. 1), defined as ‘risk of flood depth of 0.3 m during a rainfall event with a 1 in 200 change of occurring’ (Newcastle City Council, 2011). At the time of initiation of the LAA in Newcastle there were already examples of BGI and SuDS resulting from public and private investment both in response to flooding and reduction of existing risk and as part of localised plans to enable development and supply much needed housing expansion. For example the Council worked with their main partners, the Environment Agency (EA) and Northumbrian Water, to deliver UFRM projects, e.g. the Brunton Park flood alleviation scheme that realigned a section of the Ouseburn and prioritised SuDS for surface water storage (Northumbrian Water, 2016). However no city-wide vision or masterplan existed and the funding and ownership of schemes had been established with on a case by case basis. In managing flood risk, Newcastle City Council, the Lead Local Flood Authority, acknowledge the importance of a collaborative approach in

their Local Flood Risk Management Plan (Newcastle City Council, 2016a). SuDS and BGI are key components of recent planning documents, e.g. the Core Strategy and Urban Core Plan for Gateshead and Newcastle-upon-Tyne 2010–2030 (Newcastle City Council and Gateshead Council, 2015) and the Local Flood Risk Management Plan, and have been included in recent residential developments and retrofit projects. There is thus aspiration for greater implementation of BGI in Newcastle coupled with a change in attitudes and ways of working. Nonetheless, a range of socio-political barriers hamper widespread implementation of BGI including interagency fragmentation, ineffective communication, lack of institutional capacity and expertise, and a reluctance to change practices (O'Donnell et al., 2017b).

3.1. Procedural steps and phases

The Newcastle LAA was established in 2014 by the Blue-Green Cities (BGC) research project and is ongoing. It builds on existing relationships and partnerships between City stakeholders by inviting other professional stakeholders to collaborate and co-produce a city vision for flood and urban water management. In establishing and managing the LAA we adopted the five phases and seventeen procedural steps set out by van Herk et al. (2011a) and Ashley et al. (2012), focussing on relevant problems and their solution (see Supplementary Table 1). This multi-track approach of meetings on topics of interest encouraged social learning, dissemination of stakeholder projects, and input into academic research. Different members assumed leadership roles on issues relating to their expertise and held trusted positions within the group due to their ability to inspire others. A ‘snowball’ approach was adopted to recruit new members.

In the *initiation phase*, BGC academics assumed an organisational

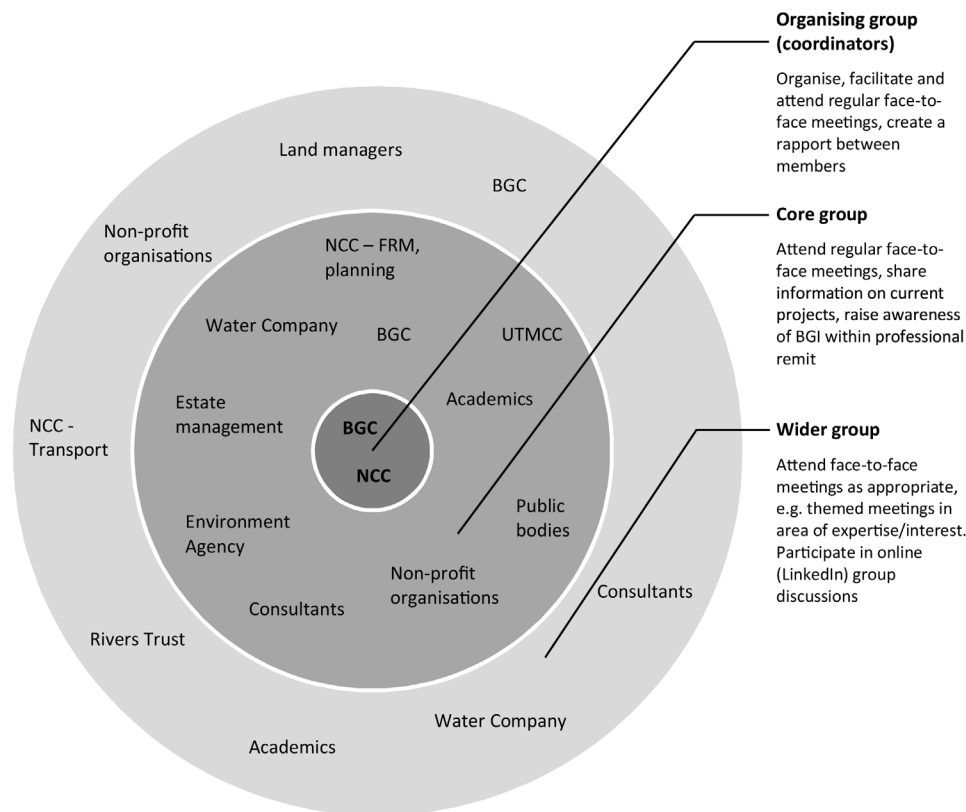


Fig. 2. Newcastle LAA membership. BGC: Blue-Green Cities team, NCC: Newcastle City Council, UTMCC: Urban Traffic Management Control Centre, FRM: Flood Risk Management team.

role and established a core group of UFRM professionals from Newcastle, including the Local Authority, EA, Water Company, and Newcastle University in their dual role as academic input and a major landowners/estate management. Individuals were invited to join the LAA based on stakeholder mapping, which ensured that all relevant disciplines and perspectives were represented to increase the potential for widespread social learning (Everett and Lamond, 2014). A pivotal step was to define how these individuals and their organisations would benefit from participating in the LAA. This was essential first, to justify the *pro bono* investment of time and effort required by LAA members and, second, to manage expectations regarding likely personal and institutional returns of that investment.

Phase two (*scoping and context*) set the context for social learning by identifying the political and physical reach of the LAA and membership levels (organising, core and wider group). Membership was limited to academics and tactical stakeholders, i.e. individuals who can directly implement changes to city infrastructure and policy, make decisions or access funding (Fig. 2). Inclusion of stakeholders working outside of flood and water management widened the discourse and allowed access to a wider range of potential funders. In this context, the LAA advanced beyond the traditional paradigm that scientists/researchers are the sole source of expertise and knowledge relevant to address resource dilemmas (Ison et al., 2007). Membership requirements were also based on the need to develop a level of professional coherence in a 'safe' atmosphere unscrutinised by the general public (Newman et al., 2011). Some LAAs have included the general public to reduce the risk of returning to traditionally 'siloes' ways of working. Nonetheless, membership is specific to each individual LAA and discussion between core members during the establishment phase will determine when it may be appropriate to include a non-tactical stakeholder presence. After *scoping and context*, LAA meetings focussed on *creating a shared vision*.

3.2. Developing a shared vision and the Newcastle declaration

LAAs typically develop shared visions in response to 'wicked'

problems. Rittel and Webber (1973) suggested that discussion should be "based on a model of planning as an argumentative process in the course of which an image of the problem and of the solution emerges gradually among the participants, as a product of incessant judgment, subjected to critical argument". This aligns with LAA visioning. The development of Newcastle's Blue-Green vision exemplifies community interaction learning, whereby collaborative working is used to develop trust within groups, enhance networking and allow stakeholders with different perspectives, knowledge and expertise, to learn from each other as the vision develops (Koontz, 2014).

The LAA's vision is for Newcastle to become a city that follows the principles of a Blue-Green City by maximising opportunities to achieve multiple benefits of Blue-Green approaches to surface water management. This includes reducing flood risk; enhancing social capital through better relationships with water and green infrastructure; improving air quality and urban biodiversity; reducing urban heat, and; creating healthier communities with improved quality of life (the full vision is given in the Supplementary material). The Newcastle LAA's overarching goal is to promote and realise this vision by taking every opportunity to influence the strategies of decision-makers. Accompanying the vision are a) the terms of reference; denoting roles and responsibilities of members, expectations placed on their participation, and protocols for group communication and data sharing, and b) strategic objectives to facilitate achievement of the vision (Supplementary material).

Identifying demonstration projects that can be championed by the LAA highlights where social learning may progress into action, playing an important role in envisioning a different UFRM future. In Newcastle, this was achieved through participatory geographic information system methods to identify spatial locations of existing and planned BGI, and opportunities for new BGI. Ranking of potential demonstration projects continued the co-learning, while negotiation of the agreed outcomes developed the shared vision. Subsequently, a hypothetical 'Blue-Green future' for the Newcastle urban core was created through further negotiation and collaborative design that reflected the preferences of the

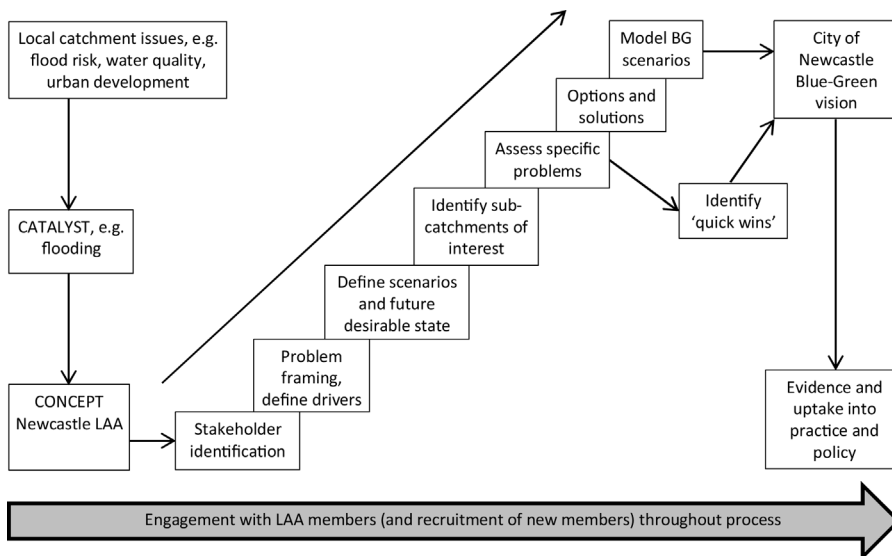


Fig. 3. Theoretical framework for how a Blue-Green vision can be negotiated and actioned by stakeholders (a modification of a runoff management framework in (Wilkinson et al., 2014)).

broad spectrum of LAA members. This incorporated their knowledge of the hydrological system, potential regeneration strategies, positioning of infrastructure, social characteristics of the area, and existing plans for future BGI. Sharing of detailed knowledge of the urban core informed thinking on where it would be possible to implement BGI and the types of assets necessary to optimise provision of multiple benefits (Supplementary Fig. 1). The hypothetical Blue-Green future fed back into the BGC research project, with modelling used to assess the degree to which BGI could reduce future flood risk, and the spatial distribution and value of co-benefits that could accrue (Morgan and Fenner, 2017 Morgan and Fenner, in press).

The shared vision, together with the model-based evidence for the advantages of a Blue-Green future for Newcastle provided the foundation for concerted actions including, most notably, the ‘Newcastle Declaration on Blue and Green Infrastructure’, drafted by the LAA and launched by Newcastle City Council in February 2016. The Declaration was initially signed by six key public and private organisations actively involved in flood risk and water management (Newcastle City Council, 2016b). In addition to committing signatories to prioritising use of BGI in managing flood risk, the Declaration pledges greater collaboration (with opportunities for social learning) through commitments to pilot new ways of working to realise the multiple benefits of BGI approaches.

By empowering the LAA to integrate BGI into current projects and so deliver benefit ‘quick-wins’, the Declaration moved the LAA into the fourth phase, *implementation*. For instance, LAA members are exploring possibilities for including BGI in planned investments in renewed urban transportation infrastructure. This will increase the benefit footprint, enabling the City to better manage surface water while meeting the primary objectives of the transport scheme and improving urban livability.

The Newcastle LAA is moving towards the final phase, *capture*, where the performance of the actions implemented to achieve the vision are evaluated and new goals for the LAA are negotiated, including the recruitment of stakeholders central to upscaling and accelerating innovation.

4. Discussion

The ‘wicked’ problem of urban flood and water management and governance pose challenges to traditional approaches as it moves beyond the capacity of a single organisation to understand and resolve (APSC, 2012). Indeed, one Newcastle LAA member specifically noted the importance of collaborative working and the need to include new knowledge to deliver multifunctional infrastructure;

“there probably was, more or less, the sort of expertise [in Newcastle City Council] to run the flood risk management side, but perhaps less so in that sort of multidisciplinary approach that you need to take to SuDS...there's a real need to bring in perhaps landscape architecture and ecologists, and other public engineers and planners” (Respondent #13, data presented in O'Donnell et al., 2017b).

Governance structures that enable stakeholder participation and collaborative working have become increasingly widespread in environmental management (Benson et al., 2013), where discussion and negotiation lead to social learning and the gaining of new knowledge (individual or collective) to enable change (Bandura, 1977; Pahl-Wostl, 2009; Gerlak and Heikkila, 2011). LAAs exemplify deliberative governance; creating a space for different institutions, agencies, groups, and organisations to debate both technical and social issues. By stepping outside the institutional setting and setting the goal of influencing decisions rather than actioning change the LAA circumvents the constraining issues of power relationships and avoids questions of responsibility sharing during the learning and visioning process. The LAA framework enables stakeholders to progress from siloed-thinking and knowledge preservation towards an integrated approach that promotes knowledge sharing and inclusivity to deliver urban flood resilience. New forms of partnership made possible by LAAs are capable of overcoming barriers to innovation. Consequently, the LAA framework facilitates transition from over-reliance on ‘grey’ infrastructure to more sustainable and resilient solutions that promote ‘living with water’ (van Herk et al., 2011b).

The integrated and holistic approach of LAAs builds shared knowledge and visions (*learning*) and encourages *action* towards a common goal. By empowering members to talk freely outside the constraints of existing formal institutional settings, creativity and innovation are fostered as members are less likely to begin negotiations from entrenched positions (Pahl-Wostl et al., 2008). Mutual trust allows discussion that envisions novel solutions rather than being mired in issues of regulatory compliance. This is particularly relevant when discussing BGI and other ‘non-traditional’ approaches to UFRM which are not currently supported by legislation, absent from standard practice and regarded by many (e.g. policy-makers, practitioners and communities) as a ‘novelty’ (O'Donnell et al., 2017b). Fig. 3 illustrates the framework that the Newcastle LAA followed to develop the Blue-Green vision. This is based on co-production of knowledge to identify interventions that address local issues and meet the needs of multiple stakeholders, working towards subsequent incorporation into policy and practice to engender a change in delivery of UFRM solutions.

Engagement of LAA members and recruitment of new members throughout the process are the foundations of the framework and fundamental to continued social learning.

4.1. Social learning within the Newcastle LAA

Social learning within the Newcastle LAA increased organisations' and individuals' capacities to manage differences in perspectives and behaviours, reframe knowledge, make collective decisions based on negotiation and conflict resolution, and learn about the drivers that motivate particular courses of action. The Newcastle LAA also supported three threads of decision-making; 1) analysing and addressing problems, 2) developing and proposing solutions, and 3) bringing participants together and seeking political commitment to influence politics (van Herk et al., 2011a). The success of such collaborative working and stakeholder participation may be valued through 'intermediary outcome' evaluations, which refer to the enhancement of social capital and trust through networking, and the development of 'process' products such as agreements and knowledge sharing (Carr et al., 2012). Intermediary outcomes of the Newcastle LAA included co-production of emergent, contextualised knowledge, and enhanced social interactions between stakeholders. Together, these strengthened existing relationships and forged new relationships to provide the basis for concerted action. Development, exchange and application of new knowledge progressed from the linear 'mode one' approach to knowledge production by researchers and experts, towards a 'mode two' approach comprising social and institutional learning, interaction of multiple actors and co-production of knowledge by the stakeholders who need and will use it (Gibbons et al., 1994).

The LAA successfully created a forum for the discussion of innovative approaches needed to overcome barriers to UFRM innovation in Newcastle, by drawing together scattered information and uniting stakeholders to a common cause (the Blue-Green vision). Interactions enabled by the visioning process supported consensual decision-making, as demonstrated by creation of a hypothetical 'Blue-Green future' for the Newcastle urban core. The 'Newcastle declaration on Blue and Green Infrastructure', an example of a 'process' product (Carr et al., 2012), demonstrates a new mindset of key stakeholders that favours collaborative working and sets a foundation for action.

The effectiveness stakeholder participation in environmental management can also be evaluated by social learning (Benson et al., 2016). While this was not explicitly measured within the Newcastle LAA, social learning at multiple levels was evident from observations made by the researchers during meetings. Collaboration between stakeholders (particularly those not typically included in UFRM), in negotiation of the Blue-Green vision and Declaration illustrates social learning on a short-medium time scale. Widening membership beyond traditional UFRM professionals brought more of the beneficiaries and enablers of Blue-Green approaches into the circle. This was vital because members of the Newcastle LAA from outside the water sector were often working independently in implementing BGI to meet non-UFRM objectives. As mentioned by one LAA member when asked who is leading, and who should lead, BGI initiatives in Newcastle;

"Honestly, I think it's a collective effort... But I think in different ways everybody is going on that journey and part of that is through the work of the Blue Green Cities [research project] and the LAA" (Respondent #15, data presented in O'Donnell et al., 2017b).

The Newcastle LAA facilitated knowledge sharing on current BGI projects and developed into a forum within which members were comfortable with freely exchanging ideas and sharing plans for new projects that were not yet publically available. This demonstrated trust and respect between members, creating the foundation for enduring collaboration. Relationships formed and strengthened by the LAA generated splinter partnerships and new actor networks that pursued issues of mutual interest. This exemplifies longer-term social learning,

which also created scope for leveraging non-water related funding streams to aid the delivery of BGI through collaborative schemes. When questioned by researchers, LAA members attested that many of the opportunities for collaboration in Newcastle might not have arisen without their involvement in the LAA.

The LAA is also a functional action-research mechanism (Sutherland et al., 2012). Researchers from the BGC project were stakeholders in the processes that they were researching, and social learning increasingly became an operational concept applied to the participatory research process. Equality of status between researchers and other LAA members aided that process and promoted the inclusive, bottom-up and non-bureaucratic LAA governance structure. Researchers from other projects also chose to engage with the LAA, demonstrating the contrast with other mechanisms such as steering groups, expert guidance and advisory boards. In summary, the Newcastle LAA assisted academic researchers in engaging with urban water management and governance issues, and the regular exchange of information between researchers and practitioners ensured that research focused on the needs of end-users.

Longer term changes in governance and cultural norms were not achieved in the lifetime of the Newcastle LAA and, notwithstanding progress made in social learning and its transformation into action, traditional approaches to UFRM governance are still evident. The LAA has no mandate or authority to change planning and management practices. Nevertheless, innovative ideas discussed during LAA meetings are beginning to be incorporated into plans as LAA members influence decision-making processes within their respective organisations. For instance, the Newcastle LAA has motivated City leaders to move towards more sustainable UFRM and the City has committed to "managing flooding in a more natural way whilst still obtaining the benefits from using green infrastructure", as stated in the Local Flood Risk Management Plan (Newcastle City Council, 2016a), which also specifically mentioned the Newcastle LAA under the 'Policies, Plans and Strategies' section (pp 34–35). The success of the Newcastle Declaration on Blue and Green Infrastructure in attracting signatories is also evidence of progress made by the LAA in progressing the Blue-Green vision.

4.2. Recommendations

An effective LAA provides opportunities for social learning and the development of new knowledge needed to enable innovation in the management of key socio-environmental issues. Lessons learned from the Newcastle LAA are presented here in the context of the literature review provided earlier, to make recommendations concerning the establishment and operation of LAAs in other cities and contexts.

4.2.1. Membership

Membership must be inclusive, embracing as many as possible of the stakeholders that can affect, or be affected by, the functioning of the LAA or implantation of its shared vision. Engagement with beneficiary communities is essential for flexible and transparent decision-making that embraces diverse knowledges and values (Reed, 2008) and can help consensus be reached in policy discussions (Thaler and Priest, 2014). However multi-loop social learning requires a building of trust between the members that allows for deep reflexive discussions and challenging of organisational norms and practices. Such trust may be constrained by inclusion of beneficiary communities if professionals perceive that community members may struggle to decouple the individual member views from their organisational stance. For Newcastle, LAA membership was limited to academic researchers and tactical stakeholders in order to respect the stated preferences of the founding members. Furthermore as a non-statutory and non-decision making body the Newcastle LAA is seeking to influence early options appraisal that will be subject to a wider debate and public engagement if stakeholders move towards implementation of aspects of the vision.

Inclusion of public representatives may be desirable, but will necessarily be dependent on the local context and specific objectives of the LAA and advantages and disadvantages should be considered at the outset and re-evaluated periodically.

Detailed stakeholder mapping should provide the basis for initial recruitment of LAA members, focussing on identifying the importance of involving each stakeholder group, their interests, motivations, and what outcomes or change could be produced through their involvement. While the Newcastle LAA aimed for a broad and balanced representation from different stakeholder organisations this was not always achieved, and the disciplines represented in group meetings were often predisposed towards UFRM. This was observed to become prevalent once the LAA moved from learning to action, and non-UFRM stakeholders (with less direct decision making capacity) perhaps felt their contribution to be less relevant and attendance of less value. To counter this tendency, it may be necessary for the organising group to review attendance and engagement regularly to support the guiding principles of the LAA.

In summary, empirical experience gained in Newcastle reinforces the theoretical case for including in a LAA a wide range of city actors, e.g. developers, social housing corporations and major landowners who are responsible for large parts of the City estates. This is needed to support transition to sustainable water management and BGI, and represents a continuing objective of the Newcastle LAA.

4.2.2. Organisation

LAA organisation by a neutral party (e.g. an academic research project) gives the alliance freedom to address new and politically sensitive problems (van Herk et al., 2011a) and diverge from traditional working regimes bounded by systems constructed by their organisations. Successful LAAs are typically driven by a strong core group with ideas and enthusiasm to maintain momentum and create an atmosphere that promotes social learning. Ideally, this will include members from each key stakeholder organisation (in Newcastle, this was the Local Authority, EA, Water Company, and Newcastle University in their dual role as academic input and major landowner/estate management) to devise topics of mutual interest.

Resilience can be built into the LAA by creating shared ownership amongst core members that reduces the impact of key members leaving. The coordinator plays an essential role in creating a rapport between LAA members (particularly in the early stages) and is key to creating trust and generating enthusiasm for involvement in the LAA. Coordinators are pivotal in managing potentially conflicting relationships between LAA members that may be a constraint to effective dialogue, for instance, based on past negative working experiences, differing personalities or difficulties in leaving vested organisation interests outside (Dudley et al., 2013). The open and frank discussion promoted by the LAA framework may help overcome these issues by creating an atmosphere where people respect sensitivities and can talk informally. In the initial stages, activities designed to allow diverse voices to be heard without censor, such as the use of post-it notes and canvassing anonymous “elephants in the room” establishes the scope of contested issues and diverse views that must then be acknowledged as valid unless, and until, shared learning changes individuals’ standpoint.

Once trust has been established, LAAs aim to manage conflict arising from the different viewpoints, positions, and levels of technical knowledge of the system being analysed, through discussion and negotiation. In Newcastle, this was aided by discipline-spanning champions who promoted the overall objectives of the LAA rather than the viewpoints of their organisations. Champions are also essential for the presentation of innovative ideas in formal inter-organisational decision-making processes and helping ensure widespread dissemination of the innovation message (van Herk et al., 2011b). Champions tend to arise organically due to enthusiasm and personal commitment towards promoting the vision. Champions and coordinators should actively encourage members to engage in social learning and dialogue rather than

simply informing other members in a top-down approach (Ashley et al., 2012). Champions may also help keep momentum of the LAA and work with organisations who may not be interested in collaborating more widely, to try and achieve alignment of the vision for all major City stakeholders.

4.2.3. Social science practices

Social science practices, such as world cafés, can be effective in promoting discussion and overcoming institutional barriers in meetings, and are advocated for interactive information exchange, knowledge production and eventual social learning. The limited success of the online Newcastle LAA platform demonstrates that face-to-face contact between members remains the most effective forum for negotiation and development of a shared vision.

5. Conclusion

Collaborative working and stakeholder participation are frequently recommended as mechanisms to enhance flood and water management decision-making. This facilitates the transition from solely ‘grey’ infrastructure to a more resilient approach that employs non-traditional water management, BGI, and encourages provision of multiple benefits. Nonetheless, a range of barriers may reduce the efficacy of potential partnerships, including ineffective communication within and between departments and organisations; fragmented responsibilities; ‘siloed’ thinking; and perceptions that ‘it is someone else’s problem’.

Social and active learning initiatives, such as LAAs, encourage collaboration by allowing stakeholders to discuss issues of shared interest in an atmosphere of mutual trust and ownership, and break-down barriers to information sharing. Social and active learning via LAAs help build capacity to address complex socio-political and environmental problems in societies characterised by changing climate, land-use economies and demographics. The LAA framework fosters collaboration and development of innovative, negotiated solutions that challenge restrictive regulations and conventional norms. Inclusion of non-water management professionals in UFRM discussions through mechanisms such as LAAs may encourage greater acknowledgement of the multiple benefits of BGI, and can help a range of organisations and departments meet their strategic objectives through the provision of multifunctional blue-green space. By bringing together different understandings of a problem through the negotiation of a shared vision, the LAA may change members’ understanding through co-production of knowledge, ultimately leading to the emergence of innovative solutions built on trust, legitimacy and transparency.

In this paper we evaluate the LAA framework as a catalyst for changing practices towards collaborative working and facilitating the transition to more sustainable UFRM, using the Newcastle LAA as a case study. Social learning through the Newcastle LAA increased organisations’ and individuals’ capacities to manage differences in perspectives and behaviours and reframe knowledge. The social learning ensuing from the Newcastle LAA encouraged members to evolve from traditional ‘siloed’ activities and perceptions of responsibilities towards an integrated, inclusive approach to develop common visions and work towards urban flood resilience.

A Blue-Green vision was negotiated by LAA members from a wide range of organisations and disciplines, exploring options for regenerating and retrofitting Newcastle towards a ‘Blue-Green City’ that maximises the opportunities to achieve multiple benefits of BGI. The signing of the ‘Newcastle Declaration on Blue and Green infrastructure’ is a first step towards demonstrating high level buy-in and support for the LAA’s vision, helping legitimise the LAA and promote longevity. The LAA framework may thus provide a platform for organisations to use in delivering innovation and adaptation through social learning that can be applied at city, catchment or regional scales.

Acknowledgements

This research was performed as part of an interdisciplinary project undertaken by the Blue-Green Cities Research Consortium (www.bluegreencities.ac.uk). This work was supported by the UK Engineering and Physical Sciences Research Council [grant number EP/K013661/1], with additional contributions from the Environment Agency and Rivers Agency (Northern Ireland). We thank Newcastle LAA members for their contributions. To maintain confidentiality, discussion and outcomes of LAA meetings cannot be made openly available. Parties interested in this data should contact the corresponding author. The associated metadata is available at <https://doi.org/10.17639/nott.60>.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <https://doi.org/10.1016/j.envsci.2017.10.013>.

References

- APSC, 2012. Tackling Wicked Problems: A Public Policy Perspective. Ausrtalian Public Service Commission, Canberra, Australia.
- Adaptation Sub-Committee, 2012. Climate Change – is the UK Preparing for Flooding and Water Scarcity. Committee on Climate Change, London.
- Ashley, R., Blanksby, J., Newman, R., Gersonius, B., Poole, A., Lindley, G., Smith, S., Ogden, S., Nowell, R., 2012. Learning and Action Alliances to build capacity for flood resilience. *J. Flood Risk Manage.* 5, 14–22. <http://dx.doi.org/10.1111/j.1753-318X.2011.01108.x>.
- Ashley, R., Walker, L., D'Arcy, B., Wilson, S., Illman, S., Shaffer, P., Woods-Ballard, B., Chatfield, P., 2015. UK sustainable drainage systems: past, present and future. *Proc. ICE – Civil Eng.* 168, 125–130. <http://dx.doi.org/10.1680/cien.15.00011>.
- Bandura, A., 1977. *Social Learning Theory*. Prentice Hall, Englewood Cliffs, NJ.
- Batchelor, C., Butterworth, J., 2008. Learning Alliance briefing note 9: visioning (draft). SWITCH FP6 Programme. http://www.switchurbanwater.eu/outputs/pdfs/WP6-2_BRN_9_Visioning_draft.pdf accessed 23.09.16.
- Benson, D., Jordan, A., Smith, L., 2013. Is environmental management really more collaborative? A comparative analysis of putative 'paradigm shifts' in Europe, Australia, and the United States. *Environ. Plann. A* 45, 1695–1712. <http://dx.doi.org/10.1068/a45378>.
- Benson, D., Lorenzoni, I., Cook, H., 2016. Evaluating social learning in England flood risk management: an 'individual-community interaction' perspective. *Environ. Sci. Policy* 55, 326–334. <http://dx.doi.org/10.1016/j.envsci.2015.05.013>.
- Bos, J.J., Brown, R.R., Farrelly, M.A., 2013. A design framework for creating social learning situations. *Global Environ. Change* 23, 398–412. <http://dx.doi.org/10.1016/j.gloenvcha.2012.12.003>.
- Carr, G., Blöschl, G., Loucks, D.P., 2012. Evaluating participation in water resources management: a review. *Water Resour. Res.* 48 (11), 1–17. <http://dx.doi.org/10.1029/2011WR011662>.
- Defra, 2005. Making Space for Water: Taking Forward a New Government Strategy for Flood and Coastal Erosion Risk Management Delivery Plan. Defra, London.
- Dudley, E., Ashley, R., Manojlovic, N., van Herk, S., Blanksby, J., 2013. Learning and Action Alliances for innovation and active learning in a European context. In: 8th International Conference. Planning and Technologies for Sustainable Urban Water Management, Lyon, France.
- Environment Agency, 2010. Working with Natural Processes to Manage Flood and Coastal Erosion Risk: A Guidance Document. Environment Agency, Bristol.
- Environment Agency, 2014. Flood and Coastal Erosion Risk Management Long-term Investment Scenarios (LTIS). Environment Agency, Bristol.
- Everett, G., Lamond, J., 2014. A conceptual framework for understanding behaviours and attitudes around 'Blue?Green' approaches to flood-risk management. *Flood Recovery, Innovation and Response IV* 184, pp. 101.
- FWMA, 2010. Flood and Water Management Act, 2010. Elizabeth II. Chapter 29. Her Majesty's Stationery Office, London, UK.
- Gerlak, A.K., Heikkilä, T., 2011. Building a theory of learning in collaboratives: evidence from the Everglades restoration program. *J. Public Adm. Res. Theory* 21, 619–644. <http://dx.doi.org/10.1093/jopart/muq089>.
- Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P., Trow, M., 1994. *The new production of knowledge: The dynamics of science and research in contemporary societies*. Sage.
- Gourgoura, P., Blätgen, T., Lykou, A., Birkmann, J., Makropoulos, C., 2015. Learning and Action Alliances: a tool for flood risk governance in coastal areas. The case of Rethymno, Crete. In: 14th International Conference on Environmental Science and Technology (CEST 2015). Rhodes, Greece. pp. 3–5.
- Hoyer, J., Dickhaut, W., Kronawitter, L., Weber, B., 2011. Water Sensitive Urban Design: principles and inspiration for sustainable stormwater management in the city of the future. Jovis.
- Hurlbert, M., Gupta, J., 2017. The adaptive capacity of institutions in Canada Argentina, and Chile to droughts and floods. *Reg. Environ. Change* 17, 865–877.
- Ison, R., Röling, N., Watson, D., 2007. Challenges to science and society in the sustainable management and use of water: investigating the role of social learning. *Environ. Sci. Policy* 10, 499–511. <http://dx.doi.org/10.1016/j.envsci.2007.02.008>.
- Ison, R., Blackmore, C., Iaquinio, B.L., 2013. Towards systemic and adaptive governance: exploring the revealing and concealing aspects of contemporary social-learning metaphors. *Ecol. Econ.* 87, 34–42. <http://dx.doi.org/10.1016/j.ecolecon.2012.12.016>.
- Koontz, T.M., 2014. Social learning in collaborative watershed planning: the importance of process control and efficacy. *J. Environ. Plann. Manage.* 57, 1572–1593. <http://dx.doi.org/10.1080/09640568.2013.820658>.
- Margerum, R.D., Robinson, C.J., 2015. Collaborative partnerships and the challenges for sustainable water management. *Curr. Opin. Environ. Sustain.* 12, 53–58. <http://dx.doi.org/10.1016/j.cosust.2014.09.003>.
- Medema, W., Wals, A., Adamowski, J., 2014. Multi-loop social learning for sustainable land and water governance: towards a research agenda on the potential of virtual learning platforms. *NJAS – Wageningen J. Life Sci.* 69, 23–38.
- Morgan, M., Fenner, R., 2017. Spatial evaluation of the multiple benefits of sustainable drainage systems. *Proceedings of the Institution of Civil Engineers – Water Management* 0, 1–14. <http://dx.doi.org/10.1680/jwama.16.00048>.
- Newcastle City Council and Gateshead Council, 2015. Planning for the Future – Core Strategy and Urban Core Plan for Gateshead and Newcastle upon Tyne 2010–2030. <http://www.newcastle.gov.uk/planning-and-buildings/planning-policy/core-strategy-and-urban-core-plan> accessed 18.01.16.
- Newcastle City Council, 2011. Preliminary Flood Risk Assessment Final Report August 2011. <https://www.newcastle.gov.uk/sites/default/files/wwwfileroot/planning-and-buildings/planning/pfrafinalreportaugust2011.pdf> (accessed 20.04.17).
- Newcastle City Council, 2016a. Local Flood Risk Management Plan. https://www.newcastle.gov.uk/sites/default/files/wwwfileroot/environment-and-waste/flood-management-newcastle/2016.03.31_complete_and_final_rpt_-_lfrmp_march_2016_1.pdf (Accessed 26.09.16).
- Newcastle City Council, 2016b. Newcastle Declaration on Blue and Green Infrastructure. https://www.newcastle.gov.uk/sites/default/files/wwwfileroot/environment-and-waste/climate-change-and-energy-saving/bluegreencities_pledge_-_signed.pdf accessed 23.09.16.
- Newman, R., Ashley, R., Molyneux-Hodgson, S., Cashman, A., 2011. Managing water as a socio-technical system: the shift from 'experts' to 'alliances'. *Proc. ICE-Eng. Sustainability* 164, 95–102. <http://dx.doi.org/10.1680/ensu.1000032>.
- Northumbrian Water, 2016. Major Newcastle Flood Scheme Complete. https://www.nwl.co.uk/media-centre/611_6749.aspx accessed 26.09.16.
- O'Donnell, E., Woodhouse, R., Thorne, C., 2017a. Evaluating the multiple benefits of a Newcastle surface water management scheme. *Proc. ICE – Water Manage.* <http://dx.doi.org/10.1680/jwama.16.00103>.
- O'Donnell, E., Lamond, J., Thorne, C., 2017b. Recognising barriers to implementation of Blue-Green infrastructure: a Newcastle case study. *Urban Water J.* 1–11. <http://dx.doi.org/10.1080/1573062X.2017.1279190>.
- Pahl-Wostl, C., Craps, M., Dewulf, A., Mostert, E., Tabara, D., Taillieu, T., 2007. Social learning and water resources management. *Ecol. Soc.* 12 (2).
- Pahl-Wostl, C., Mostert, E., Tabara, D., 2008. The growing importance of social learning in water resources management and sustainability science. *Ecol. Soc.* 13, 24.
- Pahl-Wostl, C., 2009. A conceptual framework for analysing adaptive capacity and multi-level learning processes in resource governance regimes. *Glob. Environ. Change* 19 (3), 354–365.
- Ramsbottom, D., Sayers, P., Panzeri, M., 2012. Climate Change Risk Assessment for the Floods and Coastal Erosion Sector. Defra Project Code GA0204. Report to Defra. (London, UK).
- Reed, M.S., 2008. Stakeholder participation for environmental management: a literature review. *Biol. Conserv.* 141, 2417–2431. <http://dx.doi.org/10.1016/j.biocon.2008.07.014>.
- Rittel, H.W., Webber, M.M., 1973. Dilemmas in a general theory of planning. *Policy Sci.* 4, 155–169.
- Sutherland, A., da Silva Wells, C., Darthe, B., Butterworth, J., 2012. Researchers as actors in urban water governance? Perspectives on learning alliances as an innovative mechanism for change. *Int. J. Water* 6, 311–329.
- Thaler, T., Priest, S., 2014. Partnership funding in flood risk management: new localism debate and policy in England. *Area* 46, 418–425. <http://dx.doi.org/10.1111/area.12135>.
- Thorne, C.R., Lawson, E.C., Ozawa, C., Hamlin, S., Smith, L.A., 2015. Overcoming uncertainty and barriers to adoption of blue-green infrastructure for urban flood risk management. *J. Flood Risk Manage.* <http://dx.doi.org/10.1111/jfr.12218>.
- Verhagen, J., Butterworth, J., Morris, M., 2008. Learning Alliances for integrated and sustainable innovations in urban water management. *Waterlines* 27, 116–124. <http://dx.doi.org/10.3362/1756-3488.2008.014>.
- van Herk, S., Zevenbergen, C., Ashley, R., Rijke, J., 2011a. Learning and Action Alliances for the integration of flood risk management into urban planning: a new framework from empirical evidence from the Netherlands. *Environ. Sci. Policy* 14, 543–554. <http://dx.doi.org/10.1016/j.envsci.2011.04.006>.
- van Herk, S., Zevenbergen, C., Rijke, J., Ashley, R., 2011b. Collaborative research to support transition towards integrating flood risk management in urban development. *J. Flood Risk Manage.* 4, 306–317. <http://dx.doi.org/10.1111/j.1753-318X.2011.01113.x>.
- Wilkinson, M.E., Quinn, P.F., Barber, N.J., Jonczyk, J., 2014. A framework for managing runoff and pollution in the rural landscape using a Catchment Systems Engineering approach. *Sci. Total Environ.* 468–469, 1245–1254. <http://dx.doi.org/10.1016/j.scitotenv.2013.07.055>.